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PSP Cover Sheet (Attach to the front of each proposal)

Proposal Title: Treating Ballast Water Discharges at Existing Municipal Wastewater Treatment Plants

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Amount of funding requested: $ 118460 for _____ years

Indicate the Topic for which you are applying (check only one box).

- ☐ Fish Passage/Fish Screens
- ☐ Habitat Restoration
- ☐ Local Watershed Stewardship
- ☐ Water Quality
- ☒ Introduced Species
- ☐ Fish Management/Hatchery
- ☐ Environmental Education

Does the proposal address a specified Focused Action? ____ yes X no

What county or counties is the project located in? San Francisco, Contra Costa

Indicate the geographic area of your proposal (check only one box):

- ☐ Sacramento River Mainstem
- ☐ Sacramento Trib: _____
- ☐ San Joaquin River Mainstem
- ☐ San Joaquin Trib: _____
- ☐ Delta: _____
- ☐ East Side Trib: _____
- ☐ Suisun Marsh and Bay
- ☐ North Bay/South Bay: _____
- ☐ Landscape (entire Bay-Delta watershed)
- ☒ Other: relevant to entire Bay/Delta region

Indicate the primary species which the proposal addresses (check all that apply):

- ☑ San Joaquin and East-side Delta tributaries fall-run chinook salmon
- ☑ Winter-run chinook salmon
- ☑ Late-fall run chinook salmon
- ☑ Delta smelt
- ☑ Splittail
- ☑ Green sturgeon
- ☑ Migratory birds
- ☑ Other: all species potentially affected
- ☑ Spring-run chinook salmon
- ☑ Fall-run chinook salmon
- ☑ Longfin smelt
- ☑ Steelhead trout
- ☑ Striped bass
- ☑ All chinook species
- ☒ All anadromous salmonids

Specify the ERP strategic objective and target (s) that the project addresses. Include page numbers from January 1999 version of ERP Volume I and II:

Eliminate introductions of new species in ballast water. Prevent the introduction of the zebra mussel, halt the introduction of invasive aquatic plants (Vol I, p 420)

Programmatic Action "Help find ballast water treatment techniques" (Vol II, pp 112, 151)

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Treating Ballast Water Discharges at Existing Municipal Wastewater Treatment Plants

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Type of organization:
501(c)(3) Non-profit Research Institute
Tax ID #94-2951373

Executive Summary

Background and Objectives: Although various authorities have stated that treating marine ballast water in municipal wastewater treatment plants (WWTPs) is impossible due to the impact of the chlorides in the ballast water on the biological processes of secondary wastewater treatment, preliminary investigations indicate that there exists a substantial capacity to treat ballast water in municipal WWTPs in the San Francisco Bay/Delta region without exceeding the target chloride levels for those plants.

This project will::

- investigate and report on the limiting factors that are likely to restrict the volume of ballast water that can be treated at municipal WWTPs.
- determine, for ports in the San Francisco Bay region and for selected other ports in North America, the portion of incoming ballast water that could be treated at the municipal WWTPs that serve the port region without exceeding those limiting factors.
- estimate the cost to treat that water at a representative set of ports, including treatment charges, cost of ship retrofitting and associated on-shore piping to offload ballast water and transport it into the sewer system, and the cost of any necessary buffer storage.
- test the effectiveness of standard municipal wastewater treatment to remove or kill ballast water organisms using benchtop wastewater treatment models.

Methods:
(1) Initial investigations indicate three types of potential limiting factors on the volume of ballast water that may be treated at existing municipal WWTPs: the plants flow volume may be exceeded at some times of the year; ballast water may raise the chloride levels to exceed the target operating levels for the plant's secondary treatment system; and in plants that reclaim wastewater for reuse, ballast water may raise the chloride levels to exceed the target levels for reclaimed water. Wastewater engineers at municipal WWTPs in the San Francisco Bay region and elsewhere will be interviewed to obtain information on the limiting conditions at their plants.

(2) Based on these limiting factors, on estimates of the volume of incoming ballast water at various San Francisco Bay region and selected North American ports (e. g. from Carlton et al. 1995, Cohen 1998, etc.), on information on the salinity of arriving ballast water, and on the flow volumes at plants that serve the areas of these ports, the portion of ballast water arriving at these ports that could be treated at existing municipal WWTPs will be estimated.

(3) Costs for such treatment will be made based on (1) treatment charges derived from interviews with staff at these WWTPs, (2) cost estimates for retrofitting ships and operating costs to discharge ballast water to shore, based on estimates made in several studies, and (3) estimates of the costs for on-shore piping and buffer storage needed to handle those volumes of ballast water.

(4) To test the effectiveness of treating ballast water in municipal WWTPs, dual benchtop models involving standard primary and secondary wastewater treatment will be constructed at the San Francisco's Southeast WWTP. Models will be run with a mix of influent and an appropriate percentage (not exceeding the limting factors) of "test ballast water" (explained below) and the effluent tested for the presence of viable organisms, by microscopic examination (for motile zooplankton and phytoplankton), and appropriate culturing techniques (for bacteria, dinoflagellate cysts, diatom spores, etc.). Test ballast water will consist of bay or ocean water, or of artificial seawater spiked with test organisms, for different tests. If organisms are found to survive the primary and secondary treatments, disinfection stages using chlorine or UV will be added to the models to test for survival through the disinfection process.
Location: The laboratory and analytical work will be conducted at SFSU's Romberg Tiburon Center in Marin County and the San Francisco Estuary Institute in Contra Costa County, with supplemental laboratory work at CDFG/IEP in San Joaquin County and USGS in San Mateo

County. Ships will be sampled at all Bay/Delta commercial ports, which are located in Sacramento, San Joaquin, Solano, Contra Costa, Alameda, San Mateo and San Francisco counties.

Cost: The request to CALFED is for $118,460 for this one-year project. In-kind contributions of staff time, laboratory space, some equipment and supplies, and some laboratory analyses will be provided by the City and County of San Francisco, and are estimated at about $23,000.

Applicant Qualifications: Project Leader **Andrew Cohen** has conducted extensive research on nonindigenous species and transport vectors in the Bay/Delta Estuary and other west coast estuaries, including research on the rate of invasions (published in Science) and ballast water in the Estuary. He has organized and led teams of taxonomists and ecologists in Rapid Assessment Surveys for nonindigenous species in the Bay/Delta Estuary and Puget Sound, and was recently awarded a Pew Fellowship in Marine Conservation to investigate biological invasions in tropical marine ecosystems. Project co-leader **Arleen Navarret** has 17 years experience with the San Francisco's wastewater treatment plants and processes and has also conducted research on ballast water biota.

Local Support/Coordination: The San Francisco and Contra Costa County Board of Supervisors and Planning Departments, the Delta Protection Commission and the Bay Conservation and Development Commision have been advised of the proposed project. The Center for Marine Conservation and the San Francisco BayKeeper are aware of the proposed project and strongly support it. The Director of the Southeast WWTP and the director of the water quality laboratory have reviewed the project and are enthusiatic about it. Staff at the Port of Oakland and the Port of Sacramento have been advised of the proposed project. Participants in other ballast water treatment studies in the Bay/Delta Region, including staff at the Central Contra Costa Sanitary District, Contra Costa Water District, Port of Oakland, SWRCB and San Francisco Bay RWQCB either have been or will be notified of this study, and will have an opportunity to review methods and results.

Compatibility with CALFED objectives: A programmatic action listed in the ERP (Vol. II, pp. 112, 151) is "Help fund ballast water treatment techniques that could eliminate non-native species before ballast water is released." More broadly, CALFED's Strategic Plan states that "in order to minimize the risk of potentially massive ecological and biological disruptions associated with non-native species disruptions that could threaten to negate the benefits of restoration efforts, it is important to initiate an early program that prevents or significantly reduces additional introductions of non-native species." Strategic objectives include preventing the "establishment of additional non-native species" and rehabilitating "the capacity of the Bay-Delta system to support, with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities, in ways that favor native members of those communities." The vision for non-native aquatic species is to "reduce their adverse effects on the foodweb and on native species resulting from competition for food and habitat and direct predation," including impacts on such important native and nonnative species as delta smelt, longfin smelt and striped bass whose recovery is among CalFED's objectives.

This project directly relates to the following ERP expectations, targets, actions and objectives:

- "Eliminate further introductions of new species in ballast water of ships" (Vol. I, p. 420; Vol. II, pp. 112, 151). "Eliminate the dumping of all organism-contaminated ballast water and ballast sediment into the estuary" (Vol. I, p. 464). "Develop and implement a ballast water management program to halt the introduction of introduced species into the estuary" (Vol. II, p. 151).

The ERP notes that the introduction of new species greatly increases the expense and difficulty of restoring the estuary, and that a new invasion can destroy the value of a restoration project (Vol. I, p. 464); and that the elimination of additional species introductions is crucial to the ultimate success of the ERP (Vol. I, p. 462, citing the Strategic Plan).

Project Description

Problem Statement and Objectives

Although various authorities have stated that treating marine ballast water in municipal wastewater treatment plants (WWTPs) is impossible due to the impact of the chlorides in the ballast water on the biological processes of secondary wastewater treatment (e. g. Carlton et al. 1995; Port of Oakland 1998), or simply ignored the possibility altogether (e. g. Marine Board 1996), ballast water from ships entering dry docks in San Francisco Bay has been routinely pumped into city sewer systems and treated in municipal WWTPs since 1997. Preliminary investigations indicate that there exists a substantial capacity to treat ballast water in municipal WWTPs in the San Francisco Bay/Delta region without exceeding the target chloride levels for those plants. The critical questions are not whether ballast water can be treated in these plants, but how much can be treated, how much will it cost, and how effective is the treatment at removing or killing the organisms in ballast water?

This project has four specific research objectives:

- To investigate and report on the limiting factors that are likely to restrict the volume of ballast water that can be treated at municipal WWTPs.
- To determine, for ports in the San Francisco Bay region and for selected other ports in North America, the portion of incoming ballast water that could be treated at the municipal WWTPs that serve the port region without exceeding those limiting factors.
- To estimate the cost to treat that water at a representative set of ports, including treatment charges, cost of ship retrofitting and associated on-shore piping to offload ballast water and transport it into the sewer system, and the cost of any necessary buffer storage.
- To test the effectiveness of standard municipal wastewater treatment to remove or kill ballast water organisms using benchtop wastewater treatment models.

Scope of Work

Investigation of limiting factors: Initial investigations indicate three types of potential limiting factors on the volume of ballast water that may be treated at existing municipal WWTPs: the plants flow volume may be exceeded at some times of the year; ballast water may raise the chloride levels to exceed the target operating levels for the plant's secondary treatment system; and in plants that reclaim wastewater for reuse, ballast water may raise the chloride levels to exceed the target levels for reclaimed water. Wastewater engineers at municipal WWTPs in the San Francisco Bay region and elsewhere will be interviewed to obtain information on the limiting conditions at their plants.

Assessment of potential for treatment: Based on these limiting factors, on estimates of the volume of incoming ballast water at various San Francisco Bay region and selected North American ports (e. g. from Carlton et al. 1995, Cohen 1998, etc.), on information on the salinity of arriving ballast water, and on the flow volumes at plants that serve the areas of these ports, the portion of ballast water arriving at these ports that could be treated at existing municipal WWTPs will be estimated.

Assessment of costs: Costs for such treatment will be made based on (1) treatment charges derived from interviews with staff at these WWTPs, (2) cost estimates for retrofitting ships and operating costs to discharge ballast water to shore, based on estimates made in several studies, and (3) estimates of the costs for on-shore piping and buffer storage needed to handle those volumes of ballast water.

Testing the effectiveness of treatment: To test the effectiveness of treating ballast water in municipal WWTPs, dual benchtop models involving standard primary and secondary wastewater treatment will be constructed at the San Francisco's Southeast WWTP. Models will be run with a mix of influent and an appropriate percentage (not exceeding the limting factors) of "test ballast water" (explained below) and the effluent tested for the presence of viable organisms, by microscopic examination (for motile zooplankton and phytoplankton), and appropriate culturing techniques (for bacteria, dinoflagellate cysts, diatom spores, etc.). Test ballast water will consist of bay or ocean water, or of artificial seawater spiked with test organisms, for different tests. If organisms are found to survive the primary and secondary treatments, disinfection stages using chlorine or UV will be added to the models to test for survival through the disinfection process.

Schedule and Deliverables

This is a 2-year project, with sampling conducted over 18-20 months of the project period.

- A one-year progress report will include the analysis of historic shipping data; a description of the progress to date on the ballast water sampling and analysis, with any problems encountered; and information on the diversity and abundance of the organisms in and the chemical and physical characteristics of the ballast water as determined to that date.

- A meeting/workshop will be held, including all project principals and collaborators and affected regulators, resource managers, stakeholders. etc., to review the progress report and consider whether modifications should be made in the sampling program during the remainder of the project period and whether funds should be sought to continue ballast water sampling beyond the initial project period.

- The final project report will contain the full set of analyses and data from the project.

Location/Boundaries

The laboratory and analytical work will be conducted at the Southeast Wastewater Treatment Plant in San Francisco County; work on some of the tasks will be done at the offices of the San Francisco Estuary Institute in Contra Costa County (see enclosed map).

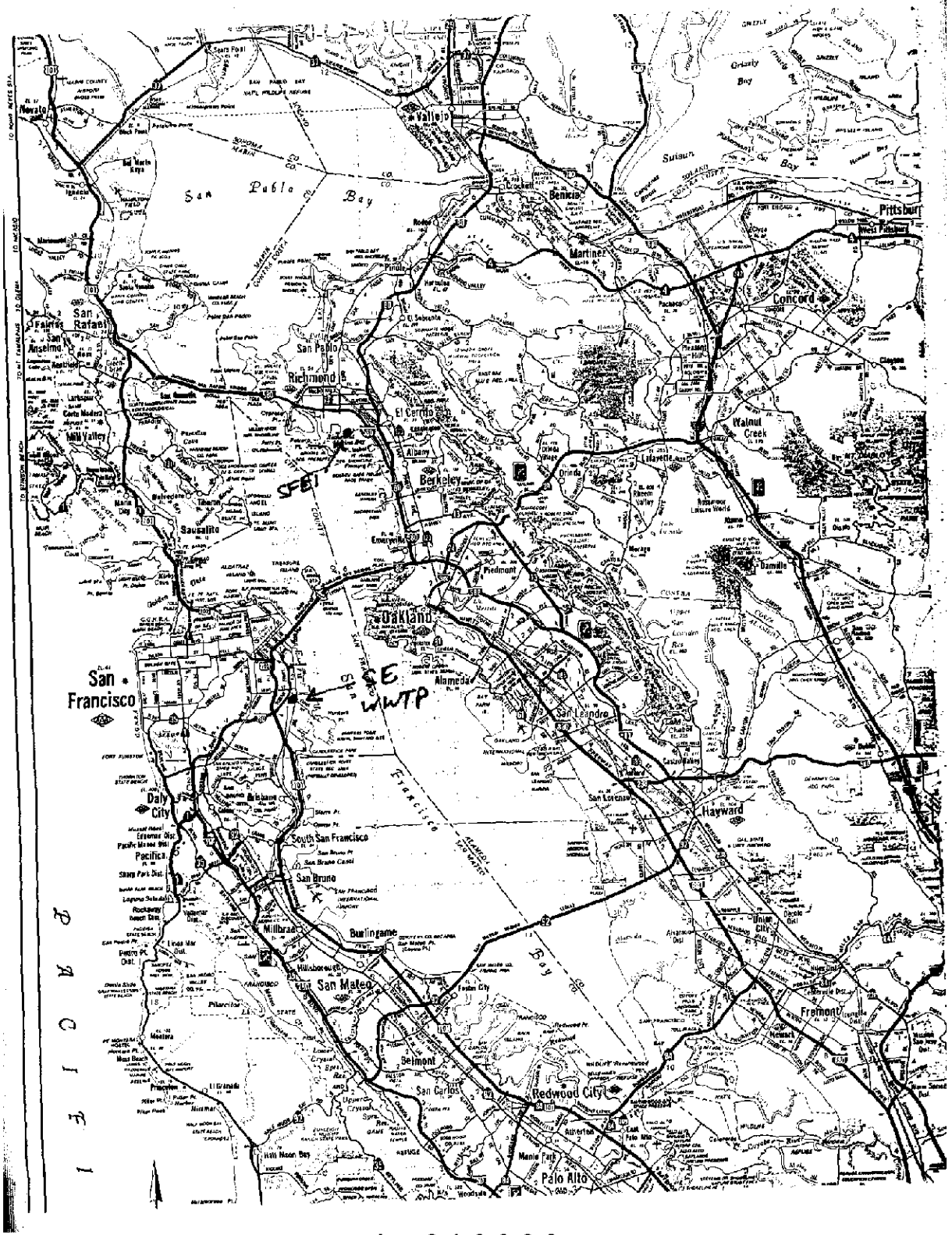
References

Carlton, J. T., Reid, D. M. and H. van Leeuwen. 1995. *Shipping Study. The Role of Shipping in the Introduction of Nonindigenous Aquatic Organisms to the Coastal Waters of the United States (other than the Great Lakes) and an Analysis of Control Options*. Report No. CG-D-11-95, U. S. Coast Guard, Groton CT and U. S. Dept. of Transportation, Washington DC.

Cohen, A. N. 1998. Ships' ballast water and the introduction of exotic organisms into the San Francisco Estuary. A report for CALFED and the California Urban Water Agencies, Sacramento.

Marine Board. 1996. *Stemming the Tide: Controlling Introductions of Nonindigenous Species by Ships' Ballast Water*. Marine Board Committee on Ships' Ballast Operations. National Academy Press, Washington DC.

Port of Oakland. 1998. Berths 55-58 Project Draft Environmental Impact Report, Appendix F: Technical Memorandum, Ballast Water Management, Port of Oakland (prepared by Dames & Moore, San Francisco CA).



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Project Benefits

Ecological/Biological Objectives

Effective and cost-effective treatment methods to remove or kill the nonindigenous aquatic species transported in ballast water are urgently needed, and are called for in the National Invasive Species Act of 1996, the International Maritime Organization's Guidelines on Ballast Water Management and many other government documents and studies. Determining how much ballast water may be treated in existing municipal WWTPs, how effective the treatment would be, and how much it would cost would be of benefit to state and federal agencies with responsibility for preventing the introduction of NIS into aquatic ecosystems (including in California, for example, the Department of Fish and Game, the State Water Resources Control Board and Regional Water Quality Control Boards, California Environmental Protection Agency and the State Lands Commission; similar agencies in other states; and at the federal level, the U. S. Coast Guard, the U. S. Fish and Wildlife Service, the National Oceanic and Atmospheris Administration, the U. S. Department of Agriculture, the U. S. Environmental Protection Agency, and other agencies as directed by the Presidential Executive Order #13112); of benefit to stakeholders at risk of impacts from invasions (such as the aquaculture and commercial fishing industries, recreational boaters and fishers, water agencies and power plants, and the general public); and of benefit to inductries that are required or may soon be required to manage ballast water to prevent the introduction of NIS (including the shipping industry, the oil industry, and port and marine terminal opearators).

As administrative and legal actions in California and elsewhere, and recently introduced law in California (Assembly Bill 703), may soon require the treatment of ballast water, information on the cost and effectiveness of potential treatment approaches is urgently needed.

Linkages

Links to other projects: This project integrates with other studies on ballast water sampling and treatment for which funding has been committed or is being sought. A ballast water sampling project proposed to CALFED and National Sea Grant by SFEI, the Romberg Tiburon Center and the San Francisco Bay Regional water Quality Control Board would provide detailed information on ballast water chemistry and biota, which may be of use respectively for the assessment of potential treatment volumes and the assessment of treatment effectiveness in this study. A second study of on-shore ballast water treatment will focus on industrial treatment plants, modification or augmentation of existing municaipal WWTPs, or the construction of ballast-water specific treatment plants, and on an overall feasibility study of on-shore treatment and cost comparison to ship-board treatment. USFWS has committed $80,000 in funding toward that study. These two treatment studies are thus completely complementary.

Links to CALFED's overall objectives: CALFED's Strategic Plan states that "in order to minimize the risk of potentially massive ecological and biological disruptions associated with non-native species disruptions that could threaten to negate the benefits of restoration efforts, it is important to initiate an early program that prevents or significantly reduces additional introductions of non-native species." Strategic objectives include preventing the "establishment of additional non-native species" and rehabilitating "the capacity of the Bay-Delta system to support, with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities, in ways that favor native members of those communities." The vision for non-native aquatic species is to "reduce their adverse effects on the foodweb and on native species resulting from competition for food and habitat and direct predation," including impacts on such important native and nonnative species as delta smelt, longfin smelt and striped bass whose recovery is among CalFED's objectives.

Links to the ERP: This project directly relates to the following ERP expectations, targets, actions and objectives:

- "Help fund ballast water treatment techniques that could eliminate non-native species before ballast water is released" (Vol. II, pp. 112, 151).
- "Eliminate further introductions of new species in ballast water of ships" (Vol. I, p. 420; Vol. II, pp. 112, 151). "Eliminate the dumping of all organism-contaminated ballast water and ballast sediment into the estuary" (Vol. I, p. 464). "Develop and implement a ballast water management program to halt the introduction of introduced species into the estuary" (Vol. II, p. 151).
- "Prevent the introduction of the zebra mussel into California" (Vol. I, p. 420).
- "Halt the introduction of invasive aquatic...plants into central California" (Vol. I, pp. 420, 456).

The ERP notes that the introduction of new species greatly increases the expense and difficulty of restoring the estuary, and that a new invasion can destroy the value of a restoration project (Vol. I, p. 464); and that the elimination of additional species introductions is crucial to the ultimate success of the ERP (Vol. I, p. 462, citing the Strategic Plan).

Links to agency mandates: Several state and federal agencies have initiated efforts to manage the release of exotic species in ballast water or may have responsibility for doing so under various statutes or administrative actions, and this study will provide information that is useful and perhaps critical for those efforts. Responsible or potentially responsible agencies include:

- the RWQCBs—the San Francisco Bay RWQCB has initiated the setting of a Total Maximum Daily Loading (TMDL) for exotic species discharged in ballast water, with regulations to follow;
- SWRCB—which has proposed including ballast water regulations in the California Ocean Plan; both the SWRCB and the RWQCBs may have direct responsibility for ballast water discharges under California's Porter-Cologne Water Quality Act;
- USFWS—which may have responsibilities under the federal Endangered Species Act or the the National Invasive Species Act (NISA);
- US EPA—which may be required to regulate ballast water under the Clean Water Act;
- US Coast Guard—under NISA.

Other laws which may establish agency responsibilities for managing ballast discharges include the federal lace Act (affecting USFWS) and various provisions of the California Fish and Game Code (affecting CDFG). The recent Presidential Executive Order #13112 directs federal agencies to take all necessary steps to prevent the introduction of invasive species, which may reasonably include regulating ballast discharges.

System-Wide Ecosystem Benefits

Nonindigenous organisms introduced into and established in one part of the Bay/Delta watershed may readily spread to other parts. For example the Asian clam *Potamocorbula amurensis*, apparently first established in the Suisun Bay, quickly spread throughout the lower bay, and the Chinese mitten crab *Eriocheir sinensis*, first reported from the South Bay in 1992, has spread throughout the Bay and Delta and well up into the tributary waterways of the Central Valley and the Bay region, and is apparently still spreading. Apparently all parts of the watershed may be at risk from invasions by nonindigenous species established by ballast discharges anywhere in the Bay/Delta system. So, by contributing to efforts to manage ballast discharges in the Bay/Delta system this project may provide benefits throughout the watershed.

Controlling the introduction of nonindigenous species in ballast discharges may link with other ecosystem elements and objectives. For example, introduced species may compete with native or other important sport or food species for food, may displace or alter the available food resources of important species and disrupt trophic pathways, may make some contaminants more bioavailable. Abundant fouling or clogging organisms—such as zebra mussels, the freshwater Asian clam *Corbicula fluminea*, mitten crabs or aquatic plants—may impair the functioning of fish protective devices such as fish screens in the Delta and tributary rivers, may obstruct fish salvage operations, or may interfere with the safe passage of fish up fish ladders.

Compatibility with Non-Ecosystem Objectives
As noted in the ERP, aquatic invasions have harmed public health, decimated fisheries and impeded or blocked water supplies (Vol. I, p. 464). The introduction of burrowing organisms such as mitten crabs may accelerate bank erosion and pose a threat to Delta levee integrity. By supporting efforts to control the release of exotic species in ballast discharges, this project could reduce risks to water supply reliability, levee integrity, and water quality.

I-019906

Feasibility and Timing

Alternatives Considered

As ballast water from ships entering the drydock at Hunters Point is currently pumped into the city sewer system and treated at the Southeast WWTP, we considered sampling the ballast water and the plant effluent at appropriate time to determine whether ballast water organisms are being removed or killed. However, due to the extreme dilution of the ballast water and some difficulties in sampling dlarge volumes of the effluent, we determined that this probably would not be effective.

Benchtop treatment process models are routinely used for testing or WWTP processes and the technology and scaling of these models is well developed, so we determinced that a benchtop testing approach is the most feasible one.

Compliance Documents

No compliance documents will be needed to conduct this project.

Monitoring/Data Collection

Objectives

This project has six research objectives:

- To investigate and report on the limiting factors that are likely to restrict the volume of ballast water that can be treated at municipal WWTPs.
- To determine, for ports in the San Francisco Bay region and for selected other ports in North America, the portion of incoming ballast water that could be treated at the municipal WWTPs that serve the port region without exceeding those limiting factors.
- To estimate the cost to treat that water at a representative set of ports, including treatment charges, cost of ship retrofitting and associated on-shore piping to offload ballast water and transport it into the sewer system, and the cost of any necessary buffer storage.
- To test the effectiveness of standard municipal wastewater treatment to remove or kill ballast water organisms using benchtop wastewater treatment models.

Data Collection Approach

The test ballast water that is input to the model and model effluent will be sampled for organisms , and results compared by standard statistical methods

Local Involvement

The San Francisco and Contra Costa County Board of Supervisors and Planning Departments, the Delta Protection Commission and the Bay Conservation and Development Commision have been advised of the proposed project. The Center for Marine Conservation and the San Francisco BayKeeper are aware of the proposed project and strongly support it. The Director of the Southeast WWTP and the director of the water quality laboratory have reviewed the project and are enthusiatic about it.

Staff at the Port of Oakland and the Port of Sacramento have been advised of the proposed project. Participants in other ballast water treatment studies in the Bay/Delta Region, including staff at the Central Contra Costa Sanitary District, Contra Costa Water District, Port of Oakland, SWRCB and San Francisco Bay RWQCB either have been or will be notified of this study, and will have an opportunity to review methods and results.

Cost

Budget Explanation

This discussion refers to budget tables 3 and 4. This is a 1-year project.

Salary & Benefits: Benefits are calculated at 18.95% of salary.

Service Contracts: Service contracts are for consulting and academic oversight for construction and operation of the wastewater treatment models.

Material and Acquistion Costs: We listed equipment purchases in this category. These include pumps, plumbing needs, UV lamps and other materials needed to construct the models; and laboratory equipment for culturing and detecting the test organisms.

Miscellaneous and Other Direct Costs: These include $4000 for laboratory supplies including cultures, culture medium, test reagents, artificial seawater, etc.for task 4; $1000 for oxygen to operate the models, for task 4; local travel @$400, listed under task 4; travel to present papers at scientific meetings for project participants @$3000, listed under tasks 2 and 4; and miscellaneous costs including purchase of reports or software, shipping, copying, printing, etc. listed under tasks 1, 3, 4 and 5.

Overhead and Indirect Costs: Overhead is calculated at 37.08% of salary and benefits plus 7.0% of service contracts.Overhead rates were calculated by standard methods for federal contracts. State overhead rates are 53.36% on salary and benefits plus 7.0% on service contracts.

Schedule

Tasks 1-3, investigating the factors limiting the volume of ballast water that can be treated in existing WWTPs, calculating the amount that can be treated in existing WWTPs, and assessing the costs for that treatment approach, will be completed in the first six months. Construction of the basic benchtop models (primary & secondary treatment) and startup operation will take place during the first quarter. A final report will be prepared during the last quarter.Payments could be tied to progress on completing tasks 1-3, constructing the benchtop models, and producing the final report.

Cost Sharing

Staff time, laboratory space, some equipment and supplies, and some laboratory analyses will be provided by the City and County of San Francisco. These are estimated at about $23,000. San Francisco will also provide the wastewater to run through the models, at no charge.

Table 3. Total Budget (CALFED funds only)

Task	Direct Labor Hours	Direct Salary & Benefits	Service Contracts	Material & Acquistion Costs	Misc. & Other Direct Costs	Overhead & Indirect Costs	Total Costs
1. Investigate limiting factors	62	2,727			200	1,011	3,938
2. Assess potential for treatment	62	2,727			1,000	1,011	4,738
3. Assess treatment costs	124	5,453			300	2,022	7,776
4. Test effectiveness	1,307	33,712	13,500	18,000	7,900	13,445	86,557
5. Report preparation	187	6,941			500	2,574	10,014
6. Project management	62	3,966				1,471	5,437
Total	1,805	55,525	13,500	18,000	9,900	21,534	118,459

Table 4. Quarterly Budget (CALFED funds only)

Task	Oct-Dec 99	Jan-Mar 00	Apr-Jun 00	Jul-Sep 00	Total Budget
1. Investigate limiting factors	1,969	1,969			3,938
2. Assess potential for treatment	2,369	2,369			4,738
3. Assess treatment costs	3,888	3,888			7,776
4. Test effectiveness	25,889	25,889	18,889	15,889	86,557
5. Report preparation				10,014	10,014
6. Project management	1,359	1,359	1,359	1,359	5,437
Total	35,474	35,474	20,248	27,263	118,459

I-019909

Applicant Qualifications

Project Leader Dr. Andrew Cohen is an Environmental Scientist at the San Francisco Estuary Institute, where he directs a research program on biological invasions in marine and freshwater ecosystems. He received his Bachelor's degree in Environmental Sciences and his Ph. D. in Energy and Resources from the University of California, Berkeley. He has conducted extensive research on nonindigenous species in the Bay/Delta Estuary and other west coast estuaries, and on the transport vectors introducing nonindigenous species into aquatic ecosystems.

Dr. Cohen's research activities and interests have included investigations of: the extent and rate of biological invasions in the Bay/Delta Estuary; invasions by the European green crab, the Chinese mitten crab, the Atlantic rough periwinkle, a Japanese foraminifer and other species; invasion vectors including ballast water, the aquarium/pet trade, aquaculture and the marine baitworm trade; ballast water treatment; prioritizing control efforts for nonindigenous marsh plants; the effect of species characteristics on the initial success of invasions; the effect of environmental factors on the potential spead of invasions; and the role of parasites in obstructing or facilitating host invasions.

Between 1993 and 1998 Dr. Cohen organized and led teams of taxonomic specialists and marine ecologists on five Rapid Assessment Surveys for nonindigenous species in the San Francisco Bay/Delta Estuary and in Puget Sound. He serves on the Executive Committee of the Western Regional Panel on Aquatic Nuisance Species. In 1998 he was awarded a Pew Fellowship in Marine Conservation to investigate biological invasions in tropical marine ecosystems.

In addition to overall project management, Dr. Cohen will have primary responsibility for tasks 1-3 (managing investigating the factors limiting the volume of ballast water that can be treated in existing WWTPs, calculating the amount of ballast water that can be treated in existing WWTPs, and assessing the costs for that treatment approach), and for task 5, preparing the final report. Task 4, the testing of the effectiveness of treament, will be managed jointly with Ms. Navarret, staff of the Southeast Treatment Plant, and the academic advisor.

Representative Publications

Cohen, A.N. 1998. *Ships' Ballast Water and the Introduction of Exotic Organisms into the San Francisco Estuary: Current Status of the Problem and Options for Management.* A report for CALFED, Sacramento CA.

Cohen, A.N., C.E. Mills, H. Berry *et al.* 1998. *Report of the Puget Sound Expedition, September 8-16, 1998; A Rapid Assessment Survey of Nonindigenous Species in the Shallow Waters of Puget Sound.* Dept. of Natural Resources and USFWS, Olympia WA.

Cohen, A.N. & J.T. Carlton. 1998. Accelerating invasion rate in a highly invaded estuary. *Science* 279: 555-558.

Cohen, A.N. & J.T. Carlton. 1997. Transoceanic transport mechanisms: the introduction of the Chinese mitten crab *Eriocheir sinensis* to California. *Pacific Science* 51(1): 1-11.

Cohen, A.N. & J.T. Carlton. 1995. *Nonindigenous Species in a US Estuary: A Case Study of the Biological Invasions of the San Francisco Bay and Delta.* USFWS, Washington DC.

Project co-Leader Arleen Navarret is a Senior Marine Biologist at the Oceanside Laboratory of the Water Quality Bureau of the City & County of San Francisco Public Utilities Commission, a position she has held since 1988. Prior to that she was a Water Quality Chemist with the San Francisco Public Utilities Commission (since 1982), and a Research Assistant at Woods Hole Oceanographic Institute in Massachusetts. At Woods Hole she worked with James Carlton as the primary research technician on some of the early, seminal studies on ballast water biota.

With 17 years of experience with wastewater treatment in San Francisco, along with direct knowledge of ballast water operations and conditions, Ms. Navarret is uniquely qualified to contribute to this study. She will act as liason as necessary with the Wastewater Treatment Plant and other divisions of the San Francisco PUC, and jointly manage the testing process, including participating in selecting test organisms and conditions, and sampling and testing procedures.

Other participants. The main work of constructing, maintaining and operating the benchtop treatment process models will be performed by 2 graduate students in sanitary engineering, under the general guidance of a department faculty member. A consulting engineer (Paul Pitts) will assist with the design and construction of the models and will be available for consultation regarding operation and maintenance. sanitary engineering staff at the Southeast Treatment Plant will also be available for consultation and advice, and will provide assistance where possible. Laboratory analyses needed for the operation of the models will be conducted by the Southeast Treatment Plant's laboratory.

San Francisco Estuary Institute

180 Richmond Field Station
1325 South 46th Street
Richmond, California 94804
Office (510) 231-9539
Fax (510) 231-9414

April 15, 1999

Supervisor Joe Canciamilla, Chair
County of Contra Costa
Board of Supervisors
651 Pine Street
Martinez, CA 94553

Dear Supervisor Canciamilla:

Per instructions stated in the CALFED Bay-Delta Program, February 1999 Proposal Solicitation Package, this letter serves to notify you of our intent to submit the project proposal entitled "Treating Ballast Water Discharges at Existing Municipal Wastewater Treatment Plants".

If you have any questions, please contact me.

Very truly yours,

Margaret R. Johnston
Executive Director

San Francisco Estuary Institute

180 Richmond Field Station
1325 South 46th Street
Richmond, California 94804
Office (510) 231-9539
Fax (510) 231-9414

April 15, 1999

Dennis M. Barry, AICP, Director
County of Contra Costa
Community Development Department
651 Pine Street
North Wing - 4th Floor
Martinez, CA 94553

Dear Mr. Barry:

Per instructions stated in the CALFED Bay-Delta Program, February 1999 Proposal Solicitation Package, this letter serves to notify you of our intent to submit the project proposal entitled "Treating Ballast Water Discharges at Existing Municipal Wastewater Treatment Plants".

If you have any questions, please contact me.

Very truly yours,

Margaret R. Johnston
Executive Director

San Francisco Estuary Institute

180 Richmond Field Station
1325 South 46th Street
Richmond, California 94804
Office (510) 231-9539
Fax (510) 231-9414

April 15, 1999

County of San Francisco
Board of Supervisors
Supervisor Tom Ammiano, President
City Hall
One Dr. Carlton B. Goodlett Place
Room 244
San Francisco, CA 94102-4689

Dear Supervisor Ammiano:

Per instructions stated in the CALFED Bay-Delta Program, February 1999 Proposal Solicitation Package, this letter serves to notify you of our intent to submit the project proposal entitled "Treating Ballast Water Discharges at Existing Municipal Wastewater Treatment Plants".

If you have any questions, please contact me.

Very truly yours,

Margaret R. Johnston
Executive Director

San Francisco Estuary Institute

180 Richmond Field Station
1325 South 46th Street
Richmond, California 94804
Office (510) 231-9539
Fax (510) 231-9414

April 15, 1999

Gerald Green, Director
County of San Francisco
Planning Department
1660 Mission Street
San Francisco, CA 94103

Dear Mr. Green:

Per instructions stated in the CALFED Bay-Delta Program, February 1999 Proposal Solicitation Package, this letter serves to notify you of our intent to submit the project proposal entitled "Treating Ballast Water Discharges at Existing Municipal Wastewater Treatment Plants".

If you have any questions, please contact me.

Very truly yours,

Margaret R. Johnson
Executive Director

San Francisco Estuary Institute

180 Richmond Field Station
1325 South 46th Street
Richmond, California 94804
Office (510) 231-9539
Fax (510) 231-9414

April 15, 1999

Margit Aramburu, Director
Delta Protection Commission
14215 River Road
P. O. Box 530
Walnut Grove, CA 95690

Dear Ms. Aramburu:

Per instructions stated in the CALFED Bay-Delta Program, February 1999 Proposal Solicitation Package, this letter serves to notify you of our intent to submit the project proposal entitled "Treating Ballast Water Discharges at Existing Municipal Wastewater Treatment Plants".

If you have any questions, please contact me.

Very truly yours,

Margaret R. Johnston
Executive Director

San Francisco Estuary Institute

180 Richmond Field Station
1325 South 46th Street
Richmond, California 94804
Office (510) 231-9539
Fax (510) 231-9414

April 15, 1999

Robert Tufts, Chair
San Francisco Bay Conservation
and Development Commission
30 Van Ness Avenue, Room 2011
San Francisco, CA 94102

Dear Mr. Tufts:

Per instructions stated in the CALFED Bay-Delta Program, February 1999 Proposal Solicitation Package, this letter serves to notify you of our intent to submit the project proposal entitled "Treating Ballast Water Discharges at Existing Municipal Wastewater Treatment Plants".

If you have any questions, please contact me.

Very truly yours,

Margaret R. Johnson
Executive Director

APPLICATION FOR FEDERAL ASSISTANCE

OMB Approval No. 0348-0043

1. TYPE OF SUBMISSION: Application ☐ Construction ☒ Non-Construction; Preapplication ☐ Construction ☐ Non-Construction	2. DATE SUBMITTED: April 16, 1999	Applicant Identifier	
	3. DATE RECEIVED BY STATE	State Application Identifier	
	4. DATE RECEIVED BY FEDERAL AGENCY	Federal Identifier	

5. APPLICANT INFORMATION

Legal Name: San Francisco Estuary Institute	Organizational Unit:
Address *(give city, county, State, and zip code)*: 1325 S.46th Street Richmond, CA 94804 Contra Costa County	Name and telephone number of person to be contacted on matters involving this application *(give area code)*: MARGARET R. JOHNSTON 510 23109539
6. EMPLOYER IDENTIFICATION NUMBER *(EIN)*: 94-2951373	7. TYPE OF APPLICANT: *(enter appropriate letter in box)* ☐

A. State; B. County; C. Municipal; D. Township; E. Interstate; F. Intermunicipal; G. Special District; H. Independent School Dist.; I. State Controlled Institution of Higher Learning; J. Private University; K. Indian Tribe; L. Individual; M. Profit Organization; N. Other (Specify) Non-Profit Research

8. TYPE OF APPLICATION: ☒ New ☐ Continuation ☐ Revision

If Revision, enter appropriate letter(s) in box(es) ☐ ☐

A. Increase Award B. Decrease Award C. Increase Duration D. Decrease Duration Other *(specify)*:

9. NAME OF FEDERAL AGENCY:

10. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER: ☐☐-☐☐☐

TITLE:

11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT:

12. AREAS AFFECTED BY PROJECT *(Cities, Counties, States, etc.)*:

13. PROPOSED PROJECT		14. CONGRESSIONAL DISTRICTS OF:	
Start Date: 10/99	Ending Date:	a. Applicant: 7TH	b. Project: 7TH

15. ESTIMATED FUNDING:

a. Federal	$ 118,460 .00	16. IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?
b. Applicant	$ .00	a. YES. THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON: DATE _____
c. State	$ .00	
d. Local	$ .00	b. No. ☐ PROGRAM IS NOT COVERED BY E. O. 12372 ☐ OR PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW
e. Other	$ .00	
f. Program Income	$ .00	17. IS THE APPLICANT DELINQUENT ON ANY FEDERAL DEBT? ☐ Yes If "Yes," attach an explanation. ☒ No
g. TOTAL	$ .00	

18. TO THE BEST OF MY KNOWLEDGE AND BELIEF, ALL DATA IN THIS APPLICATION/PREAPPLICATION ARE TRUE AND CORRECT, THE *DOCUMENT HAS BEEN DULY AUTHORIZED BY THE GOVERNING BODY OF THE APPLICANT AND THE APPLICANT WILL COMPLY WITH THE ATTACHED ASSURANCES IF THE ASSISTANCE IS AWARDED.*

a. Type Name of Authorized Representative	b. Title	c. Telephone Number
Margaret R. Johnston	Executive Director	510 231-9539
d. Signature of Authorized Representative		e. Date Signed

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Prescribed by OMB Circular A-102

I -019918

I-019918

OMB Approval No. 0348-0044

BUDGET INFORMATION - Non-Construction Programs

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1.		$	$	$ 118,460	$	$ 118,460
2.						
3.						
4.						
5. Totals		$	$	$	$	$

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY (1)	(2)	(3)	(4)	Total (5)
a. Personnel	$ 46,679	$	$	$	$ 46,679
b. Fringe Benefits	8846				8,846
c. Travel					
d. Equipment	18,000				18,000
e. Supplies					
f. Contractual	13,500				13,500
g. Construction					
h. Other	9,900				9,900
i. Total Direct Charges (sum of 6a-6h)					
j. Indirect Charges	21,534				21,534
k. TOTALS (sum of 6i and 6j)	$ 118,460	$	$	$	$ 118,460
7. Program Income	$	$	$	$	$

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(e) TOTALS

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I-019919

(Rev. 4-92)
Circular A-102

SECTION C - NON-FEDERAL RESOURCES

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS
8.	$	$	$	$
9.				
10.				
11.				
12. TOTAL (sum of lines 8 - 11)	$	$	$	$

SECTION D - FORCASTED CASH NEEDS

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$ 118,460	$ 35,474	$ 35,474	$ 20,248	$ 27,263
14. NonFederal					
15. TOTAL (sum of lines 13 and 14)	118,460	35,474	35,474	20,248	27,263

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

(a) Grant Program	FUTURE FUNDING PERIODS (Years) (b) First	(c) Second	(d) Third	(e) Fourth
16.	$	$	$	$
17.				
18.				
19.				
20. TOTAL (sum of lines 16-19)	$	$	$	$

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges: 96,925

22. Indirect Charges: 21,534

23. Remarks:

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I-019920

STATE OF CALIFORNIA

NONDISCRIMINATION COMPLIANCE STATEMENT

STD. 19 (REV. 3-95) FMC

COMPANY NAME

SAN FRANCISCO ESTUARY INSTITUTE

The company named above (hereinafter referred to as "prospective contractor") hereby certifies, unless specifically exempted, compliance with Government Code Section 12990 (a-f) and California Code of Regulations, Title 2, Division 4, Chapter 5 in matters relating to reporting requirements and the development, implementation and maintenance of a Nondiscrimination Program. Prospective contractor agrees not to unlawfully discriminate, harass or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, disability (including HIV and AIDS), medical condition (cancer), age, marital status, denial of family and medical care leave and denial of pregnancy disability leave.

CERTIFICATION

I, the official named below, hereby swear that I am duly authorized to legally bind the prospective contractor to the above described certification. I am fully aware that this certification, executed on the date and in the county below, is made under penalty of perjury under the laws of the State of California.

OFFICIAL'S NAME

Margaret R. Johnston

DATE EXECUTED

EXECUTED IN THE COUNTY OF

Contra Costa County

PROSPECTIVE CONTRACTOR'S SIGNATURE

PROSPECTIVE CONTRACTOR'S TITLE

Executive Director

PROSPECTIVE CONTRACTOR'S LEGAL BUSINESS NAME

San Francisco Estuary Institute

I -019921

I-019921

OMB Approval No. 0348-0040

ASSURANCES - NON-CONSTRUCTION PROGRAMS

Public reporting burden for this collection of information is estimated to average 15 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Office of Management and Budget, Paperwork Reduction Project (0348-0040), Washington, DC 20503.

PLEASE DO NOT RETURN YOUR COMPLETED FORM TO THE OFFICE OF MANAGEMENT AND BUDGET. SEND IT TO THE ADDRESS PROVIDED BY THE SPONSORING AGENCY.

NOTE: Certain of these assurances may not be applicable to your project or program. If you have questions, please contact the awarding agency. Further, certain Federal awarding agencies may require applicants to certify to additional assurances. If such is the case, you will be notified.

As the duly authorized representative of the applicant, I certify that the applicant:

1. Has the legal authority to apply for Federal assistance and the institutional, managerial and financial capability (including funds sufficient to pay the non-Federal share of project cost) to ensure proper planning, management and completion of the project described in this application.

2. Will give the awarding agency, the Comptroller General of the United States and, if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.

3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.

4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.

5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. §§4728-4763) relating to prescribed standards for merit systems for programs funded under one of the 19 statutes or regulations specified in Appendix A of OPM's Standards for a Merit System of Personnel Administration (5 C.F.R. 900, Subpart F).

6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C. §§1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. §794), which prohibits discrimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U.S.C. §§6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination on the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) §§523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. §§290 dd-3 and 290 ee 3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. §§3601 et seq.), as amended, relating to nondiscrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and, (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.

7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally-assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.

8. Will comply, as applicable, with provisions of the Hatch Act (5 U.S.C. §§1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.

9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. §§276a to 276a-7), the Copeland Act (40 U.S.C. §276c and 18 U.S.C. §874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§327-333), regarding labor standards for federally-assisted construction subagreements.

10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program and to purchase flood insurance if the total cost of insurable construction and acquisition is $10,000 or more.

11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§1451 et seq.); (f) conformity of Federal actions to State (Clean Air) Implementation Plans under Section 176(c) of the Clean Air Act of 1955, as amended (42 U.S.C. §§7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended (P.L. 93-523); and, (h) protection of endangered species under the Endangered Species Act of 1973, as amended (P.L. 93-205).

12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers system.

13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. §470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. §§469a-1 et seq.).

14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.

15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. §§2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.

16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§4801 et seq.) which prohibits the use of lead-based paint in construction or rehabilitation of residence structures.

17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act Amendments of 1996 and OMB Circular No. A-133, "Audits of States, Local Governments, and Non-Profit Organizations."

18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations, and policies governing this program.

SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL	TITLE
Mayat	Executive Director
APPLICANT ORGANIZATION	DATE SUBMITTED
San Francisco Estuary Institute	April 16, 1999

Standard Form 424B (Rev. 7-97) Back

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I-019923